Measuring the Cost of Pollution: Economic Life, Economic Theory, and the Origins of Environmental Economics

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Since the 1970s, many environmental economists have traced their discipline's roots to an economist who wrote about pollution as a social cost in the early twentieth century.[1] The economist was A. C. Pigou, an academic working in the picturesque university town of Cambridge nestled in the English countryside. The pollution was coal smoke, the "smoke nuisance" that had long plagued industrial cities. For millions of people in Britain and around the world, smoke was an environmental and economic reality. It darkened the sky and killed plants. It destroyed buildings and dirtied clothes. It crept into workplaces, homes, and bodies.

For Pigou, however, pollution was largely theoretical: an academic problem to be solved on paper. This is what Pigou did, offering one of the earliest and most influential frameworks for understanding pollution as an economic phenomenon. In so doing, he anticipated the subsequent creation of a new subdiscipline of economics concerned with environmental costs that would take off in the 1960s, for which he became an honored antecedent and lodestar.[2] But although Pigou might have been the first self-styled economist to fully grapple

[1] See David Pearce, "An Intellectual History of Environmental Economics," *Annual Review of Energy and the Environment* 27 (November 2002): 57–81; Agnar Sandmo, "The Early History of Environmental Economics," *Review of Environmental Economics and Policy* 9, no. 1 (Winter 2015): 43–63; Ottmar Edenhofer, Max Franks, and Mattias Kalkuhl, "Pigou in the 21st Century: A Tribute on the Occasion of the 100th Anniversary of the Publication of the Economics of Welfare," *International Tax and Public Finance* 28 (2021): 1090–1121.

[2] Steven Medema has argued that Pigou's treatment of externalities did not receive much attention in economic literature between the 1920s and 1950s, and that it was only resuscitated (with major revisions) in the 1950s and 1960s. Steven G. Medema, "'Exceptional and Unimportant'? Externalities, Competitive Equilibrium, and the Myth of a Pigovian Tradition," *History of Political Economy* 52, no. 1 (2020): 135–70. H. Spencer Banzhaf contends that Pigou's influence in environmental economics as it emerged as a field in the 1960s was much less significant than that of Ronald Coase and of American institutionalist economists. H. Spencer Banzhaf, "A History of Pollution (Or, Why Pigovian Taxes Are Not Necessarily Pigovian)," NBER Working Paper 27683 (2020), http://www.nber.org/papers/w27683. But Coase himself was inspired by Pigovian ideas, even if he reacted against them. Intellectual influence is not always linear or uninterrupted.

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with the problem of pollution, he was just one of many thinkers to confront the environmental costs and benefits of economic activity in the early twentieth century. As historians have amply shown, all sorts of environmental changes—whether pollution, deforestation, overfishing, or water usage—forced thinkers for many centuries to reckon with the fact that economic life bore economic costs on and through the environment.[3]

Economists have seen Pigou as a possible progenitor of their field because Pigou is legible as an economist; in fact, he was vigorous in his self-identification as such. In reality, the origins of environmental economics are multiple, even numerous, as recent scholarship has made clear.[4] The intention of this article is not to advance a singular origin story for the field, nor to replace an existing one with another.[5] The roots of economic thinking about environmental degradation go back hundreds of years at least. Certainly, no one thinker was the sole progenitor of environmental economics.

Still, Pigou is important. Not only were his ideas groundbreaking, they have also been elevated to a foundational status by practitioners of the field.[6] This article attends to Pigou because, for the past fifty years, environmental economists

[3] For just a few examples, see, on pollution, Frank Uekoetter, *The Age of Smoke: Environmental Policy in Germany and the United States, 1880–1970* (Pittsburg, 2009); William Cavert, *The Smoke of London: Energy and Environment in the Early Modern City* (Cambridge, 2016); Peter Thorsheim, *Inventing Pollution: Coal, Smoke, and Culture in Britain since 1800* (Columbus, OH, 2006); on forests, see S. Ravi Rajan, *Modernizing Nature: Forestry and Imperial Eco-Development, 1800–1950* (Oxford, 2006); David Blackbourn, *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany* (New York, 2007); on overfishing, see Bathsheba Demuth, *Floating Coast: An Environmental History of the Bering Strait* (New York, 2019); and Anthony Medrano, *The Edible Ocean: Science, Industry, and the Rise of Urban Southeast Asia* (New Haven, CT, forthcoming); on water and land, see Philipp Lehmann, "Infinite Power to Change the World: Hydroelectricity and Engineered Climate Change in the Atlantropa Project," *American Historical Review* 121, no. 1 (February 2016): 70–100; Sunil Amrith, *Unruly Waters: How Rains, Rivers, Coasts, and Seas Have Shaped Asia's History* (New York, 2018); Debjani Bhattacharyya, *Empire and Ecology in the Bengal Delta: The Making of Calcutta* (Cambridge, 2019); Fredrik Albritton Jonsson, *Enlightenment's Frontier: The Scottish Highlands and the Origins of Environmentalism* (New Haven, CT, 2013); Harriet Ritvo, *The Dawn of Green: Manchester, Thirlmere, and Modern Environmentalism* (Chicago, 2009). See also Sverker Sörlin and Paul Warde, eds., *Nature's End: History and the Environment* (London, 2009). Fredric Albritton Jonsson and Carl Wennerlind, *Scarcity: A History from the Origins of Capitalism to the Climate Crisis* (Cambridge, 2023).

[4] Banzhaf, "History of Pollution"; Medema, "Exceptional and Unimportant?"

[5] Marc Bloch, *The Historian's Craft* (New York, 1953), 24–29.

[6] For a succinct overview of Pigou's work, see David Collard, "Introduction," in A. C. Pigou, *Journal Articles, 1902–1922*, ed. David Collard (London, 2002). On Pigou's ideas within the canon of the history of economics, see Nahid Aslanbeigui and Guy Oakes, *Arthur Cecil Pigou* (London, 2015), and Karen Knight, *A. C. Pigou and the "Marshallian" Thought Style* (London, 2018). Ian Kumekawa, in *The First Serious Optimist* (Princeton, NJ, 2017), takes a wider contextual approach.

have attended to Pigou. Despite recent challenges, Pigou remains central in understandings of environmental economics' intellectual lineage. But Pigou's own economics depended on an existing network of economic thinkers, albeit thinkers who did not understand themselves to be economists. The history of environmental economics goes far beyond the story of disembedded academic theory. It is equally a story of administrative practice, political advocacy, and local economic life.[7] Contextualizing Pigou—putting him in conversation with his contemporaries—helps reveal that economic thinking about the environment was a political project, one that depended on the work of long-overlooked or forgotten figures: municipal administrators, reformers, and scientists, many of whom were women. Both they and their contributions have largely been written out of the received history of the discipline's origin, even if they appear in the wider historiography of environmental protection.[8]

This article writes these figures back in to the history of economic thought and scientific discipline-building. By doing so, it explores how pollution itself was coded as feminine by local reformers and how Pigou recoded pollution as masculine, with striking implications for his proposed remedy for it. Returning to a key moment in the received history of environmental economics, this article lays bare the dangers of abstract systemic economic thinking insufficiently tethered to local lived economic realities that were constrained by physical infrastructure.[9] Pigou, the academic theorist, had many of the same goals and ideological commitments as like-minded municipal reformers—people including Margaret Fishenden, Marion Fitzgerald, and Ernest Simon—and he drew heavily upon their work. But he diverged entirely from them in his policy

[7] On bureaucracy and the construction of economics, see among others, Arunabh Ghosh, *Making It Count: Statistics and Statecraft in the Early People's Republic of China* (Princeton, NJ, 2020); Erik Grimmer-Solem, *The Rise of Historical Economics and Social Reform in Germany, 1864–1894* (Oxford, 2003); Thomas Stapleford, *The Cost of Living in America: A Political History of Economic Statistics* (Cambridge, 2009); Adam Tooze, *Statistics and the German State, 1900–1945: The Making of Modern Economic Knowledge* (Cambridge, 2001).

[8] See, for instance, Thorsheim, *Inventing Pollution*, and Stephen Mosley, *Chimney of the World: A History of Smoke Pollution in Victorian and Edwardian Manchester* (London, 2008).

[9] On the local physical infrastructure as shaping economic lives, see Sam Wetherell, *Foundations: How the Built Environment Made Twentieth-Century Britain* (Princeton, NJ, 2020); Guy Ortolano, *Thatcher's Progress: From Social Democracy to Market Liberalism through an English New Town* (Cambridge, 2019); Abby Spinak, *Democracy Electric: Energy and Economic Citizenship in an Urbanizing America* (forthcoming). See also, more generally, Diane E. Davis and Alan Altshuler, *Transforming Urban Transport* (Oxford, 2018); Debjani Bhattacharyya, *Empire and Ecology in the Bengal Delta* (Cambridge, 2018); Paige Glotzer, *How the Suburbs Were Segregated: Developers and the Business of Exclusionary Housing, 1890–1960* (New York, 2020).

recommendations. This divergence created a tension that lies buried in the history of economics, and environmental economics in particular. The process of academic discipline-building vitally depended upon the work of thinkers outside the academy. But academic theorists deployed such work selectively, largely erasing its meaning and intent. The result was an abstract theory that, while powerful and durable, failed to confront political realities of the day. Recovering the original work and intent of nonacademic thinkers holds lessons with significant stakes for understanding the intellectual history of environmental economics as contextually embedded. Moreover, it suggests possibilities that could shape the future of the field.

A. C. Pigou and Environmental Economics

From the perspective of the history of economics, Pigou's major intellectual breakthrough was to identify certain economic activities whose costs and benefits operated such that the price system alone could not necessarily maximize societal welfare—what would come to be known as "externalities." Pollution from "factory chimneys" was one of Pigou's prime examples. "Smoke in large towns," he wrote, "inflicts a heavy uncharged loss on the community in respect of health, of injury to buildings and vegetables, of expenses of washing clothes and cleaning rooms, of expenses for the provision of extra artificial light, and in many other ways."[10]

In an argument with resonance for contemporary discourses about global warming, Pigou identified these "uncharged losses" as accruing insidiously, as unseen by-products of the normal operation of industry. Externalities like pollution might cause a great deal of collateral damage—decreased health or damage to flora and fauna—which could be expressed in economic terms, but these losses were not explicitly catalogued as external effects on any balance sheet. The result was that pollution silently supplemented the individual economic welfare of the factory owner at the expense of the social weal.[11]

Pigou identified industrial pollution as an externality in his first major work, *Wealth and Welfare*, published in 1912. By 1920 when his follow-up book, *The Economics of Welfare*, was published, pollution had become for Pigou the externality *par excellence*, a status it retains to this day. But identifying smoke pollution as an externality was only the first half of what Pigou hoped his nascent discipline, economics, could offer society. Though Pigou himself was an academic theorist, comfortably perched in a Cambridge professorship, he had reformist inclinations. His goal for economics was simultaneously lofty and grounded:

[10] A. C. Pigou, *Wealth and Welfare* (London, 1912), 159.
[11] Kumekawa, *First Serious Optimist*, chap. 3.

to "bear fruit rather than just light."[12] To do so with respect to pollution, Pigou had to offer a recommendation on what to do about the problem of smoke pollution: whether, for instance, a tax was necessary and, if so, how big it needed to be. To answer these questions, he would need to know how much economic harm smoke pollution was causing, measured in terms of money.

Pigou was acutely aware of his need for such a numerical calculation, but finding one was easier theorized than accomplished. Pigou himself had no desire to leave Cambridge to conduct what would now be called "field research." When he first wrote about pollution in 1912, he had not yet located any empirical data on the economic ill effects of pollution, despite the existence of plenty of anecdotal evidence. In fact, Pigou would not offer such data on pollution until sixteen years later, in 1928, when he included it in a footnote in the third edition of *The Economics of Welfare*.[13] The data itself came from the Manchester Air Pollution Advisory Board, a government body that had estimated that Manchester residents spent £290,000 more per year on laundry than they would if the city had clean air.[14] Pigou's footnote was an important milestone in the history of economics; it has been hailed as one of the first places—perhaps the first place—where the theory and practice of environmental economics came together.[15] But inherent in the footnote is the possibility of an earlier such conjuncture: in Manchester, with the Air Pollution Advisory Board itself.

Pollution in Manchester

The Manchester Air Pollution Advisory Board was first proposed in 1912, the same year that Pigou wrote about pollution as a "negative external effect."[16] Formed the next year, the board reported to Manchester's municipal Sanitary Committee. It thus belonged to the sprawling system of early twentieth-century British bureaucracy. It also belonged to the world of municipal politics. Local

[12] A. C. Pigou, *Economics of Welfare*, 1st ed. (London, 1920), 5; and Pigou, *Economic Science in Relation to Practice* (London, 1908), 12. See also Kumekawa, *First Serious Optimist*, chap. 3.

[13] A. C. Pigou, *Economics of Welfare*, 3rd ed. (London, 1928).

[14] Pigou, *Economics of Welfare*, 186–87n.

[15] See Sandmo, "The Early History of Environmental Economics"; Lint Barrage, "The Nobel Memorial Prize for William D. Nordhaus," *Scandinavian Journal of Economics* 121, no. 3 (2019): 884–924; Finn R. Førsund and Steinar Strøm, *Environmental Economics and Management* (London, 2013), chap. 2; Kumekawa, *First Serious Optimist*, 76.

[16] "Air Pollution: The Advisory Committee," *Manchester Guardian*, January 7, 1913, 7; Air Pollution Advisory Board Minutes (hereafter APAB), February 24, 1914, Manchester Central Library (hereafter MCL), GB127/M901/12166. Sanitary Committee Minutes, October 23, 1912, and December 18, 1912, MCL, GB127.Council Minutes/Sanitary and Public Health Committee/11, f. 142 and f. 176.

government was the epicenter of progressive legislation and governance in early twentieth-century Britain, and Manchester, a metropolis of nearly three-quarters of a million and the employer of over 25,000 people, boasted a strong reformist bent. Like many other British cities, Manchester provided its residents with gas, electricity, public transit, and water—itself the subject of previous environmental battles.[17] It administered a wide range of schools and hospitals, infant wellness centers, and sewerage facilities.[18]

Most of all, the Air Pollution Advisory Board belonged to a particular social and environmental reality. Manchester was Britain's first major industrial city. It was Cottonopolis, the center of nineteenth-century Britain's fabulously successful textile industry. Fired by Lancashire coal deposits, Manchester had become the most important hub in Britain's industrial revolution. As historian Stephen Mosley has shown, by the late nineteenth century, Manchester had come to be understood as "the chimney of the world"—the epitome not just of British industrial prowess but also of the polluted and festering industrial city.[19] By the mid-nineteenth century, air pollution was so severe that plants no longer grew in central Manchester; fresh air, green space, even a blue sky had become "meaningless terms" for the working classes.[20]

Smoke was an omnipresent part of life. As the doctor Sir Stephen Crichton Browne put it while addressing a 1902 sanitary conference in Manchester, "this is the age of smoke in which we are living. . . . You are smothered in the products of combustion all the year round; in winter these settle down on you as fogs, grim and horrible. . . . A sable incubus embraces your breathing, a hideous scum settles on your skin and clothes, a swart awning offends your vision."[21] Because Lancashire coal had a high sulfur content, the smoky air tasted extremely pungent.

[17] The Manchester Corporation dammed Thirlmere in the Lake District to provide the city increased water supplies, provoking much local resistance. Ritvo, *Dawn of Green*.

[18] See Ernest Simon, *A City Council from Within* (London, 1926); Shena D. Simon, *A Century of City Government: Manchester, 1838–1938* (London, 1938); Charlotte Wildman, "Urban Transformation in Liverpool and Manchester, 1918–1939," *Historical Journal* 55, no. 1 (2012): 119–43; Tom Hulme, "Putting the City Back into Citizenship: Civics Education and Local Government in Britain, 1918–1945," *Twentieth Century British History* 26, no. 1 (2015): 26–51. Even if the progressive alliance of Liberals and Labour weakened in the early twentieth century, Manchester had a strong history of progressive municipal politics. See Declan McHugh, "Labour, the Liberals, and the Progressive Alliance in Manchester, 1900–1914," *Northern History* 39 (March 2002): 93–108; Peter Clarke, *Lancashire and the New Liberalism* (Cambridge, 1971). On municipal reform, see Daniel T. Rodgers, *Atlantic Crossings: Social Politics in a Progressive Age* (Cambridge, MA, 1998).

[19] Mosley, *Chimney of the World*, 1–2. See also Ritvo, *Dawn of Green*, chap. 2.

[20] "E. Hamilton, "Smoke," *Pall Mall Magazine* 2 (1894): 401, quoted in Mosley, *Chimney of the World*, 36–41.

[21] *Manchester Guardian*, April 25, 1902, quoted in Mosley, *Chimney of the World*, 25. On the "age of smoke" more generally, see Uekoetter, *Age of Smoke*.

It produced devastating acid rains, which burned skin and dissolved the fine brick buildings erected with proceeds from the textile trade. Pollution was literally destroying the city. And so, the city's reformers took action. They formed a committee: the Air Pollution Advisory Board.

Advisory boards were a key part of the ecology of British governance in the early years of the twentieth century. On both the local and the national level, boards and committees were the vehicles for state action and state inaction. When a ministry, official, or city government was pressed to move on an issue, forming a committee or an advisory board on the matter was a low-cost way of gesturing toward future attention. It was also a way of generating political cover. Membership of the new body could be carefully constructed; any report could be widely circulated or, if necessary, buried.[22]

The Manchester Air Pollution Advisory Board was just such a body, formed with no particular authority but entrusted to investigate and report with a view toward providing ammunition for future action. Its budget was initially only £400 per year.[23] It was primarily directed toward education and "propaganda"; in the words of the *Manchester Guardian*, its purpose was not "of persecuting any particular class of delinquents but rather awakening all of us to a sense of our blackness . . . and teaching us how to be clean."[24]

The board was drawn from influential members of the Mancunian elite. Primarily, it was composed of politicians—city councillors and members of official committees including "Baths and Washhouses, Cleansing, Education, Electricity, Finance, Gas, Improvement and Buildings."[25] It included representatives from civil society such as W. Thomson, the chairman of the Manchester and Salford Sanitary Association, and Paul Ogden of the Manchester Society of Architects. There were scientists, including W. W. Haldane Gee, a physicist based at the Manchester Technical College, and H. B. Dixon, a University of Manchester chemist, and there were also engineers and factory owners: R. H. Clayton was a dyestuffs manufacturer, and Edward Hillier of the Manchester Association of Engineers chaired the board's executive committee.[26]

Finally, there were social reformers. Though it was the first government body specifically addressing smoke pollution in the city, the board drew inspiration from a long line of civic organizations in Manchester that had campaigned for smoke reduction since the mid-nineteenth century: the Manchester Association

[22] For a humorous view of committees, see Anthony Sampson, *Anatomy of Britain* (New York, 1962), 248–49. See also Peter Hennessy, *Whitehall* (London, 1989).

[23] APAB Minutes, February 24, 1914, MCL, GB127.M901/12166.

[24] "Dirt and Citizenship," *Manchester Guardian*, April 3, 1912, 6; "Black Smoke: The Evil and Some Ways Out," *Manchester Guardian*, April 30, 1915, 3.

[25] "Air Pollution: The Advisory Committee," *Manchester Guardian*, January 7, 1913, 7.

[26] Margaret Fishenden, *The Coal Fire* (London, 1920).

for the Prevention of Smoke, the Manchester and Salford Noxious Vapours Abatement Association, and the Smoke Abatement League.[27] The chairman of this last group, Ernest Simon, would run the Air Pollution Advisory Board.[28] Simon was a recently elected city councillor, a Fabian, and a close friend of Sidney and Beatrice Webb, with whom he had helped found *The New Statesman*. He was just two years younger than Pigou, and the two overlapped as students at Cambridge. Both were Liberals from wealthy families; both were interested in progressive social reform. But whereas Pigou took an armchair interest, Simon threw himself into local politics in his native Manchester.[29] By the time he did, the Simon name carried weight in the city. Simon's father, an immigrant from Silesia, had founded two highly successful businesses in the city. One, Henry Simon, Ltd., manufactured flour-milling machinery. The other, Simon-Carves Ltd., was one of the country's largest producers of coke ovens.[30] With his industrial money and progressive values, Ernest Simon embodied the tensions of Manchester. He was both one of the most prominent coal reformers in the city and the heir to a fortune and a company both built by burning coal in prodigious quantities.

The Economic Costs of Pollution

Simon and other members of the Air Pollution Advisory Board understood pollution in economic terms well before Pigou referenced their work in the 1928 edition of his book. In a 1919 report to city leaders—subsequently published as a widely cited pamphlet—the board explicitly framed pollution as "what may be called a black smoke tax" paid by "everybody living in Manchester." The tax was "levied on buildings, merchandise, gardens, furniture, curtains, on paint and wallpaper, on clothes, and last but not least, on personal health, and even, we might say, on personal appearance." Manchester was a "house painters' paradise" because of the costs of frequent repainting.[31] In a back-of-the-envelope

[27] Mosley, *Chimney of the World*, Pt. III. Sanitary Committee, Minutes, May 28, 1913, MCL, GB127.Council Minutes/Sanitary and Public Health Committee/12, ff. 38–40.

[28] The first chairman of the board (for less than a year) was the chair of the Sanitary Committee, W. T. Jackson; Simon was elected chair in November 1913. Sanitary Committee, Minutes, July 30, 1913, and November 26, 1913, MCL, GB127.Council Minutes/Sanitary and Public Health Committee/12, f. 52; 113.

[29] Kumekawa, *First Serious Optimist*, 8–10.

[30] Brendon Jones, "Simon, Ernest Emil Darwin, first Baron Simon of Wythenshawe," *ODNB*, 2014; Mary D. Stocks, *Ernest Simon of Manchester* (Manchester, 1963), chaps. 2 and 3. See also Brian Simon, *In Search of a Grandfather: Henry Simon of Manchester, 1835–1899* (Leicester, 1997).

[31] Manchester Air Pollution Advisory Board, *The Black Smoke Tax: An Account of Damage Done by Smoke, with an Inquiry into the Comparative Cost of Family Washing in Manchester and Harrogate* (Manchester, 1920), in MCL, GB127.M901/12166.

estimate, the Air Pollution Advisory Board figured that city residents spent nearly three-quarters of a million pounds per year on repairing damages due to smoke pollution, and it pointed out that the poorest residents bore burdens disproportionate to the rich.[32]

Even before the report (entitled *The Black Smoke Tax*) appeared, coal smoke in Manchester was beginning to be framed as an economic cost. Reformers, including those associated with the national Smoke Abatement League (based in Manchester) and the Air Pollution Advisory Board, had long urged the city to lower the cost of relatively clean-burning gas, which the municipality sold at a profit.[33] Not doing so meant levying "a tax on those Manchester citizens who are public-spirited enough—or sensible enough—to cook by gas instead of coal."[34] The league also pointed out that technical improvements—whether improved chimneys in coal-fired factories or gas-powered domestic cooking stoves—would actually save owners money on energy bills. As the *Manchester Guardian* noted in 1913, "it is by such arguments as these that the case against black smoke is supported nowadays. . . . Enthusiasts used to rail at the manufacturer and insist that willy-nilly he must be made to cease desecrating heaven and earth, our architecture, and the tissue of our lungs." But in the early 1900s, the reasoning changed from the "merely" aesthetic to the decidedly practical. "Nowadays," according to the *Guardian*, "he is chided by the interests of his own pocket."[35]

In fact, for decades, meteorologists and others concerned about Britain's smoky air and "great fogs" had understood the economic costs of smoke. Rollo Russell, a prominent meteorologist based in London, listed ten distinct kinds of damage due to coal smoke in 1880, including "extra washing," "wall-papers replaced," "restoring, gilding metalwork, shop-fronts, names of streets, . . . works of arts, monuments, &c.," the "slow destruction of stonework," "extra gas," and the wasteful "escape" of uncombusted "fuel into the atmosphere." In 1880, Russell—himself a retired Foreign Office civil servant and the uncle of Pigou's Cambridge colleague Bertrand Russell—estimated "in a very general way" the costs to people living in metropolitan London at more than £1,761,000. Nine

[32] Manchester Air Pollution Advisory Board, *Black Smoke Tax*.

[33] David Stradling and Peter Thorsheim, "The Smoke of Great Cities: British and American Efforts to Control Air Pollution," *Environmental History* 4, no. 1 (January 1999): 6–31. APAB Minutes, March 19, 1914, MCL, GB127.M901/12166.

[34] "Black Smoke Scandal: Work of the Abatement League," *Manchester Guardian*, October 16, 1913, 5.

[35] "Black Smoke Scandal: Work of the Abatement League," *Manchester Guardian*, October 16, 1913, 5. There had been a previous "Smoke Abatement League" in Manchester in the 1890s, but that merged with the Manchester and Salford Sanitary Association in 1904. See Mosley, *Chimney of the World*, 173–79; Thorsheim, *Inventing Pollution*, 54–55. Ernest Simon noted that "fortunately, on the whole, efficiency and smokelessness went together, so that research paid." "The Smoke Nuisance: £1,000,000 a Year Wasted in Manchester," *Manchester Guardian*, September 10, 1915, 4.

years later, his estimates had grown to include no fewer than twenty-four kinds of costs, including reduced capacity to work because of sickness. The estimated total cost had similarly ballooned to over £5 million per year.[36]

Calculating and mapping Manchester's pollution was the preliminary step in the Air Pollution Advisory Board's agenda. Once formed, it immediately set about creating a pollution map of the city by measuring the extent of smoke pollution at ten sites across Manchester.[37] At the same time, it sought to calculate "the economic cost of the smoke evil" "in actual money value."[38] Such a figure would be incredibly useful as a rhetorical—and thereby political—tool. It would help leverage scientific authority in making the case to both polluters and policymakers.

It was for this purpose that the Manchester Air Pollution Advisory Board employed Marion Fitzgerald, "a trained investigator, one of the [city's] Public Health Inspectors," to estimate the pollution-related laundry costs borne by city residents. Fitzgerald had come to Manchester from Woolwich in East London, where she had been a sanitary inspector, to work as Ernest Simon's private secretary.[39] Her instructions from the Air Pollution Advisory Board "were to obtain one hundred exact and comparable statements, for Manchester and Harrogate respectively, as to the cost of the weekly washing in working-class houses." Building on the results of questionnaires that the Advisory Board had previously mailed out, Fitzgerald carried out her investigations over two months, paying many house visits "largely in excess of the number of estimates required."[40] As Fitzgerald would later put it, she aimed at "being practical, domestic, and arithmetical—but, always . . . with a scientific background."[41]

[36] Rollo Russell, *London Fogs* (London, 1880), 37–41, and Russell, *Smoke in Relation to Fogs in London* (London, 1889); Bill Luckin, "'The Heart and Home of Horror': The Great London Fogs of the Late Nineteenth Century," *Social History* 28, no. 1 (January 2003): 31–48.

[37] See *First Annual Report of the Sanitary Committee on the Work of the Air Pollution Advisory Board* (Manchester, 1915).

[38] "The Public Health of Manchester: Preventative Work of the Inspectors," *Manchester Guardian*, August 30, 1915, 3; APAB, Minutes, April 13, 1916, Manchester Central Library, GB127.M901/12166.

[39] "Obituary: Miss M. Fitzgerald," *Manchester Guardian*, January 17, 1953, 2. Manchester had been inspired to conduct such a survey by following the example of Pittsburgh. See "Summary of News: General," *Manchester Guardian*, July 3, 1914, 8. Joanne Smith, "The Manchester and Salford Women Citizens' Association: A Study of Women's Citizenship" (PhD thesis, Manchester Metropolitan University, March 2007), 348.

[40] Manchester Air Pollution Advisory Board, *Black Smoke Tax*. See also Ernest Darwin Simon and Marion Fitzgerald, *The Smokeless City* (London, 1922), 79; in APAB, Minutes, December 18, 1919, MCL, GB127.M901/12166. On the questionnaires, see Report of Statistical Committee on Questionnaire, in APAB, Minutes, April 13, 1916, MCL, GB127.M901/12166.

[41] "Abatement of Domestic Smoke: Miss Fitzgerald's Lecture," *Manchester Guardian*, November 30, 1929, 16.

Fitzgerald found that working-class households in dirty Manchester were obliged to pay 7½ pence per week more on laundry than counterparts in clean Harrogate. This was a substantial sum. The average weekly pay for a British laborer in 1920 was 846 pence (roughly three and a half pounds). This meant that the *extra* laundry costs in Manchester accounted for almost a whole percent of a worker's pay.[42] The total cost that Fitzgerald calculated for all of Manchester, £242,705 per annum, was strikingly large, but still "extremely conservative." Not only did it assume that middle-class households paid no more in extra laundry costs than working-class ones; it also did not assign a money value to the lost time spent on extra washing in Manchester, where "on an average, the weekly wash was one hour longer" than in Harrogate. Counting the hours lost in the 112,616 "small houses" in the city, Fitzgerald concluded that "the sum total of time wasted in the course of a year is equivalent to . . . 668 years!"[43]

Domestic Pollution

Just as for Pigou, for the Manchester Air Pollution Advisory Board, calculating the scale of the problem posed by pollution was only the first step in a larger project of remediation.[44] The board was established "for the purpose of investigating and reporting" on pollution and finding the "best means of avoiding or minimizing the same."[45] Marion Fitzgerald had investigated pollution. Now, the board had to find a way to reduce it.

There were some clear paths forward, blazed by the Smoke Abatement League. The league placed significant emphasis on the way in which coal was burned. If burned completely, at very high temperatures, coal produces water, carbon dioxide, and ash, none of which contributed to the black smoke that covered Manchester. Smoke and soot were, in effect, small particles of coal that had not been fully combusted. Because of their scale and size, many of Manchester's industrial furnaces burned coal relatively efficiently, thereby producing relatively

[42] House of Commons Sitting, *Hansard*, July 30, 1925, Fifth Series, vol. 187, cc. 671–73.

[43] Manchester Air Pollution Advisory Board, *Black Smoke Tax*, quoted in Simon and Fitzgerald, *Smokeless City*, 79.

[44] Simon pushed the board to measure the scale of pollution, which it did through the establishment of recording stations with "soot gauges" and actinometers to measure solar radiation. Sanitary Committee, Minutes, July 30, 1913, MCL, GB127.Council Minutes/Sanitary and Public Health Committee/12, ff. 53–54; Report on Soot Collectors, July 21, 1914, and Report on Actimonetry, [n.d.], in APAB, Minutes, August 26, 1914, MCL, GB127.M901/12166.

[45] Sanitary Committee, Minutes, December 18, 1912, MCL, GB127.Council Minutes/Sanitary and Public Health Committee/11, f. 176; "Air Pollution: The Advisory Committee," *Manchester Guardian*, January 7, 1913, 7; Manchester City Council Meeting, Minutes, January 8, 1913, MCL, 352.042M22, pp. 195–96.

little smoke and soot. Domestic hearths and grates, on the other hand, could never achieve the extremely high temperatures needed for complete combustion of coal. At comparatively low temperatures, smoke particles also tended to combine with oils, forming a particularly noxious kind of sticky haze, or "smut."[46] As reported in *The Public Health Engineer*, a progressive publication, the smoke nuisance was most severe on Sundays, "when extra cooking took place over the widest area."[47] Indeed, the Smoke Abatement League admitted that Manchester's factory chimneys ran fairly efficiently.[48]

Pigou's classic treatment of smoke pollution as a public cost was influential in part because it was so simple. In his telling, people were neatly divided into two groups: villains and victims. The villains were the clutch of wealthy factory owners whose immense profits depended on filling the air with ash and soot. The victims were everyone else, but most poignantly the urban poor—many of whom were employed by the factory owners and all of whom had to choke, uncompensated, on the by-products of industry. But in Manchester and other industrial cities, the story was not so simple, as Pigou would have known if he had read the reports from Manchester at all closely. For just as almost everyone was a victim of pollution, almost everyone was also a polluter.

In the early twentieth century, the prime focus of smoke reformers' efforts had shifted from the industrial pollution of large factories toward domestic coal usage, a trend that had started in the 1880s, when smoke abatement committees sponsored exhibitions on smoke-reducing furnaces, stoves, and grates.[49] Certainly, by the time the Air Pollution Advisory Board was founded, there was increasing evidence that much of the air pollution in Manchester was due, not to factory emissions, but instead to the burning of coal in domestic settings as fuel for heating and cooking.

That said, in the early twentieth century, the question of what portion of Manchester's "smoke nuisance" was attributable to domestic sources was "hotly disputed" and remains difficult to assess.[50] While much of the visible smoke was likely caused by domestic sources, the fine particulates emitted by factories would have had disastrous health effects for Mancunians and likely contributed disproportionately to heightened morbidity and mortality rates.[51]

[46] Mosley, *Chimney of the World*, 20.

[47] *Public Health Engineer*, vol. 17, 1905, p. 127 and p. 141, quoted in Mosley, *Chimney of the World*, 51.

[48] "Black Smoke Scandal: Work of the Abatement League," *Manchester Guardian*, October 16, 1913, 5.

[49] On previous efforts to curb industrial pollution, see Carlos Flick, "Movement for Smoke Abatement in 19th-Century Britain," *Technology and Culture* 21, no. 1 (January 1980).

[50] Lord Newton, "Preface," in Simon and Fitzgerald, *Smokeless City*, v; Thorsheim, *Inventing Pollution*, 82–87.

[51] See W. Walker Hanlon, "London Fog: A Century of Pollution and Mortality, 1866–1965," NBER Working Paper 24488, October 2018, https://www.nber.org/sys

In the 1910s and 1920s, the source of the "smoke nuisance" was a political issue at the very heart of the Air Pollution Advisory Board itself. The advisory board was pitched to the city in the spring of 1912 by a whole collection of Mancunians, including doctors and "sanitary reformers," but industrialists were the real driving force behind the effort. According to the *Manchester Guardian*, "Members of the Manchester Society of Chemical Industry . . . [took] a leading part in this new and important proposal," and it was the chemical industry that had submitted a formal proposal for the establishment of an advisory board.

The language of that proposal was striking. It decried "excessive pollution of the atmosphere by coal smoke, especially that emanating from *domestic and office* chimneys"—that is, from nonindustrial chimneys.[52] In the eyes of those responsible for the Air Pollution Advisory Board, the poor not only bore the brunt of the degenerative effects of pollution but also were responsible (at least in part) for their own degeneration. Industry was not the focus of reform. As a city councillor and member of the Sanitary Committee freely admitted to the *Manchester Guardian*, there would not be "any great effort . . . to reduce the emission of smoke from mill chimneys. There was a strong feeling among members of the Sanitary Committee against harassing manufacturers."[53]

Reformers' attention to the hearth and the stove—even their emphasis on laundry costs—feminized the "smoke nuisance." It figured smoke less as the product of workplaces that typically employed men, and more as the result of domestic activity by women. This view was taken up by women actively involved in reform campaigns around smoke abatement. Octavia Hill—already well known as a housing reformer—became a highly visible leader in the movement in the 1880s, decrying pollution as degrading the lives of the urban poor and inhibiting them from accessing the beauty of nature. Instead of being able to "look up into the lovely sky," the poor could only "see far away the stretch of distant blue."[54] Hill, focused on the lived experience of housing, stressed the domestic aspects of pollution, campaigning for the poor to use more efficient stoves.[55] In Manchester, the Manchester and Salford Women Citizens' Association, founded in 1913 to encourage women to participate in municipal politics,

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tem/files/working_papers/w24488/w24488.pdf; Karen Clay, Joshua Lewis, and Edson Severnini, "Canary in a Coal Mine: Impact of Mid-20th-Century Air Pollution Induced by Coal-Fired Power Generation on Infant Mortality and Property Values," NBER Working Paper 22155, June 2019, https://www.nber.org/papers/w22155.

[52] Emphasis added. "The Smoke Nuisance: A Memorial to the City Council," *Manchester Guardian*, April 3, 1912, 14.

[53] "Municipal Trading: The Relief of Rates in Manchester," *Manchester Guardian*, March 28, 1918, 8.

[54] Octavia Hill, "More Air for London," *Nineteenth Century* 23 (Feb 1888): 188.

[55] See Thorsheim, *Inventing Pollution*, 90–94; Elizabeth Baigent, "Octavia Hill, Nature and Open Space: Crowning Success or Campaigning 'Utterly without Result,'" in *Octavia Hill, Social Activism, and the Remaking of British Society*, ed. Elizabeth

became a key supporter of local abatement efforts and eventually appointed a representative to the Smoke Abatement League. The association's membership was preoccupied by smoke. In 1918, a local branch sponsored a competition for women to write why they were a "woman citizen." The winning entry started with a couplet: "Because our clouds are often grey / And dim with smoke the summer day."[56] Personal networks also played a role in keeping smoke reform high on the association's agenda. The association was cofounded by Shena Simon, whose husband was Ernest Simon, the advisory board's chair. Marion Fitzgerald would become one of the association's most active members. At one of its first public meetings in 1914, Ernest Simon lauded the organization and noted that the Air Pollution Advisory Board was a municipal matter "of interest to women." He reiterated that "much of the smoke came from their own chimneys."[57]

The widespread belief that domestic stoves were responsible for pollution also primed reformers to employ women to work on smoke abatement research. With its focus on stoves and grates, the Air Pollution Advisory Board appointed Dr. Margaret Fishenden, a physicist who ran the University of Manchester's meteorological department, to direct its brand-new domestic heating laboratories at the Manchester College of Technology in 1916. It would offer her a scant salary of £2 per week, well under what her male colleagues were making.[58] Operating with a budget of about £500 per year, Fishenden conducted pioneering work on improving the efficiency of domestic coal fires, research that would propel her into a distinguished academic career.[59]

Fishenden's appointment came in the midst of World War I, at a moment of particular anxiety about resource scarcity. By 1915—a year into the war—Britons were confronting the realities of a straining wartime economy. Even before World War I, reformers including those on the Air Pollution Advisory Board understood soot to be wasteful. The Smoke Abatement League often pointed out that when a manufacturer did not burn coal in a high-efficiency oven, "he is flinging a considerable portion of his coal away in the form of smoke." Moreover, it

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Baigent and Ben Cowell (London, 2016), 141–62; Enid Moberly Bell, *Octavia Hill: A Biography* (London, 1942), 169–72.

[56] Smith, "Manchester and Salford Women Citizens' Association," 107–9, 160; "Municipal Trading: The Relief of Rates in Manchester," *Manchester Guardian*, March 28, 1918, 8.

[57] "Smoke and Washing Bills: What Manchester Men Pay for Soiled Collars," *Manchester Courier*, May 12, 1914, 8.

[58] APAB, Minutes, December 9, 1915, MCL, GB127.M901/12166; "Tests in Regard to Domestic Firegrates," February 16, 1915, in Air Pollution Advisory Board Meeting, Minutes, February 24, 1915, and Report on Fuel Laboratory Room, in APAB, Minutes, July 15, 1915, MCL, GB127.M901/12166.

[59] Fishenden, *Coal Fire*, vii; Julie Stevenson, "Fishenden [née White], Margaret," *ODNB*, 2004. See also Flick, "Smoke Abatement," 39–48; APAB, Minutes, February 10, 1916, and March 22, 1917, MCL, GB127.M901/12166.

estimated that about 5 percent of coal burned in domestic open grates "passes into the atmosphere in the form of soot."[60] In the midst of war, with growing concerns over "fuel economy," such waste was particularly unacceptable.[61] Smoke had always hurt the general population, but now it did so in a new and more politically untenable and unpatriotic way: by hindering the war effort. In this context, Fishenden's work was doubly important: it could alleviate the smoke nuisance and simultaneously help economize scarce resources.

Throughout World War I and its immediate aftermath, Margaret Fishenden led a small team—including "Miss Ashton, a second year Chemistry Student in the School of Technology," a "Miss Cocks," and a "Miss Boullen"—that investigated the comparative efficiencies of kitchen stoves and home heaters.[62] In each, they compared the efficiency of two types of fuel: simple bituminous coal and "low temperature carbonization coke cakes for domestic use," a solid fuel made by heating coal at low temperatures that gave off very little smoke when burned.[63] What they sought was a way of producing the most heat with the least smoke. In a report published just after World War I, Fishenden offered recommendations for the design of household appliances. As it stood, "the ordinary kitchen range . . . [was] an inefficient and ill-designed apparatus."[64] But her more definitive finding was that refined "coke cakes," as a fuel, were far more efficient and less polluting than raw coal. She urged the former's widespread adoption as a way of mitigating the smoke nuisance. Citing both *The Black Smoke Tax* and the work of Rollo Russell—who had also urged the adoption of improved domestic hearths—Fishenden reiterated the "material losses directly attributable to smoke" that were "probably inadequately realised" by the general public.[65] Coke cakes, though more expensive, would save money in the long run.

In recommending the adoption of a cleaner-burning coal product, Fishenden was proposing a relatively modest, though effective, measure to improve the air

[60] "Black Smoke Scandal: Work of the Abatement League," *Manchester Guardian*, October 16, 1913, 5; Mosley, *Chimney of the World*, 89–94.

[61] Haldane Gee, "Report Relating to Domestic Heating," in APAB Minutes, June 22, 1915, MCL, GB127.M901/12166.

[62] APAB Minutes, June 7, 1917, and January 20, 1919, MCL, GB127.M901/12166.

[63] Fishenden's work first appeared in an Advisory Board report in 1918. APAB Minutes, August 2, 1917, March 21, 1918, and January 26, 1920, MCL, GB127.M901/12166. A revised version under the title of *The Coal Fire* was widely circulated by the Department of Scientific and Industrial Research in 1920. It was condensed and republished in 1921. Margaret White Fishenden, *The Efficiency of Low Temperature Coke in Domestic Appliances* (London, 1921); David Edgerton, *The Rise and Fall of the British Nation* (London, 2018), 184–85.

[64] Fishenden, *Efficiency of Low Temperature Coke*, 34.

[65] Fishenden, *Efficiency of Low Temperature Coke*, 34; Russell, *Smoke*, 32; "The Prevention of Smoke," *Nature* 39 (November 8, 1888): 25; Russell, *London Fogs*, 11, 40.

quality of British cities. There was good reason for Fishenden's pragmatic stance. As historians have described, much of the British public associated smoke with industry, and industry with prosperity, even civilization. Nowhere was this truer than in Manchester itself. As Peter Thorsheim has contended, smoke was not coded as predominantly negative until the late nineteenth century.[66] Even then, while clean-burning gas and electricity were favored by Manchester reformers, they were understood to be too expensive to be suitable replacements for coal. As Ernest Simon and Marion Fitzgerald put it, for working-class Britons, "gas [was] at present too expensive for continuous use," even if it was cost effective for intermittent use.[67] When considering the possibility of a widespread changeover from coal to gas, Margaret Fishenden wrote: "The fact is that we are here faced with a question which cannot easily be tackled by the individual and which is, properly, a national matter. Unless its price can be substantially reduced, gas, quite apart from any sentimental prejudices in favour of coal fires, cannot compete financially with coal for continuous heating."[68] In the absence of a widespread state-led effort, Fishenden addressed herself to the individual consumer and to the private sector. Meaningful action was still possible on the smoke nuisance, even without massive state intervention. Commercial development of a "solid smokeless fuel," Fishenden concluded, "would be an immediate and satisfactory solution of the smoke problem."[69] But Fishenden was clear that more sweeping action was also necessary. What was needed was attention on a countrywide scale. Coal was a "national matter"—that is, a matter for the government in London.

From Manchester to London

Fortunately for Fishenden, London took notice of her research. Fishenden's work in Manchester was "of so important a character" that the national Department of

[66] Mosley, *Chimney of the World*, esp. Pt. II. Coal fire was associated with the cozy domestic hearth. Peter Thorsheim, *Inventing Pollution: Coal, Smoke, and Culture in Britain since 1800* (Columbus, OH, 2006); Stephen Mosley, "Public Perceptions of Smoke Pollution in Victorian Manchester," in *Smoke and Mirrors: The Politics and Culture of Air Pollution*, ed. E. Dupuis (New York, 2004), 51–57.

[67] Simon and Fitzgerald, *Smokeless City*, 51–76. The Air Pollution Advisory Board supported increased gas provision. "Gas by the Therm," *Manchester Guardian*, February 7, 1923, 9.

[68] Fishenden understood the lacuna in her work. "It may appear to be a somewhat curious aberration of reason that leads us to expend our resources upon obliterating the ravages of smoke, yet leaves us inert in regard to the problem of removing, or at least diminishing, the origin of the damage, the smoke itself." Fishenden, *Efficiency of Low Temperature Coke*, 34.

[69] Fishenden, *Efficiency of Low Temperature Coke*, 34.

Scientific and Industrial Research (DSIR) published it as a special report.[70] And on the basis of her work, Fishenden started working with the DSIR's Fuel Research Board after World War I; she would move full time to the board, based in East Greenwich, in 1922.[71]

The Fuel Research Board was an instance of the expanding British state. It was one of the many boards and bodies established under the aegis of the Department of Scientific and Industrial Research, which had been formed in 1915 to deploy scientific knowledge to difficulties in the supply of key materials like fuel.[72] The board was a wartime invention, meant to centralize power in a time of emergency, but it quickly became a permanent fixture of the state. The Fuel Board and the rest of the DSIR persisted after the end of World War I as unobtrusive and relatively low-cost ways for the British government to bolster the economic health of the country.[73] As state intervention went, the efforts of the DSIR were decidedly pro-business; the department offered gentle encouragements rather than onerous regulations. In this sense, its orientation was similar to that of the Manchester Air Pollution Advisory Board. Through both bodies, the state supported scientific research and education. Through both bodies, the state underwrote the agendas of big business.

Few businesses were bigger than coal. In the 1920s, the coal industry supported a twelfth of the British population and accounted for 10 percent of exports by value (75 percent by volume). Until the 1950s, coal powered trains, ships, and nearly all power plants, and it provided the main source of domestic heat.[74] In this context, the Fuel Research Board was not a critic of big coal, but rather a partner. The sort of state intervention that would be required to shift the country's domestic energy consumption from coal to gas would simply be too cataclysmic and wrenching to contemplate seriously.[75] Coal was central to

[70] Fishenden, *Coal Fire*, iii.

[71] Stevenson, "Fishenden [née White], Margaret," *ODNB*, 2004.

[72] Fishenden, *Coal Fire*. The DSIR established a Fuel Research Station in 1917 to research efficient use of coal. Frank Heath and Arthur Hetherington, *Industrial Research and Development in the United Kingdom* (London, 1946), 280–81; Roy M. MacLeod and E. Kay Andrews, "The Origins of the D.S.I.R.: Reflections on Ideas and Men, 1915–1916," *Public Administration* 48, no. 1 (March 1970): 23–48.

[73] The DSIR's budget in 1920 was about half a million pounds. Harry Melville, *The Department of Scientific and Industrial Research* (London, 1962), 32–38. On state-supported military research, see David Edgerton, *Warfare State: Britain, 1920–1970* (Cambridge, 2006), chap. 3.

[74] Edgerton, *Rise and Fall of the British Nation*, 80–81; *Report of the Royal Commission on the Coal Industry* (London, 1926) [Cmd. 2600].

[75] Barry Supple, *The History of the British Coal Industry,* vol. 4, *1914–1946: The Political Economy of Decline* (Oxford, 1988); Ben Fine, "Economies of Scale and a Featherbedding Cartel? A Reconsideration of the Interwar British Coal Industry," *Economic History Review* 43, no. 3 (August 1990): 438–49.

Britain's status as an economic powerhouse and important to British identity in the early twentieth century. The cheap and cheerful coal fire brightly burning in hearths across the country was a hallmark of domestic life. Despite Fishenden's hopes, shifting energy consumption away from coal was simply not a viable option, either for local municipalities or for the national government in Westminster. Structural change was hard. Calling for more research, by contrast, was painless. Fishenden's research on coal efficiency, rather than coal replacement, therefore, found a receptive audience in London; a Royal Commission on the Coal Industry praised her work and suggested further research.[76]

Still, despite coal's centrality in British life, there were reformers—including many from Manchester and Lancashire—who campaigned for legislation to curb smoke pollution. In the two years before World War I, two bills regulating commercial chimneys were introduced into Parliament, though both were withdrawn.[77] The bills had been submitted by a Lancashire landowner, Thomas Legh, Lord Newton, with the support of the Air Pollution Advisory Board.[78] To mollify Newton and his supporters after withdrawing the second bill, the Local Government Board agreed to appoint "a strong Departmental Committee . . . to examine the present state of the law and its administration" as pertaining to smoke pollution.[79] This committee had barely gotten off the ground before it was dissolved with the outbreak of World War I. But it was resurrected six years later in March 1920 as the "Departmental Committee on Smoke and Noxious Vapours Abatement," again under Newton. This time, it fell under the newly established Ministry of Health and had Ernest Simon as a member.[80]

Like the Manchester Air Pollution Advisory Board (whose work it thoroughly reviewed) Newton's committee focused on domestic, rather than industrial, coal smoke. In its interim report—released after three months of meetings—the committee estimated that domestic pollution accounted for at least half "of the total smoke nuisance."[81] In fact, the committee produced the interim report specifically

[76] *Report of the Royal Commission on the Coal Industry* (London, 1926) [Cmd. 2600], 24–26.

[77] Flick, "Movement for Smoke Abatement," 38–39.

[78] The APAB recommended regulating domestic chimneys as well. Sanitary Committee Minutes, December 17, 1913, MCL, GB127.Council Minutes/Sanitary and Public Health Committee/12, f. 130. APAB Minutes, February 24, 1914, MCL, GB127.M901/12166.

[79] Sir William Napier Shaw and John Switzer Owens, *The Smoke Problem of Great Cities* (London, 1925), 276. *Hansard* House of Lords Debate, March 24, 1914, vol. 15, c. 671.

[80] See Departmental Committee on Smoke and Noxious Vapours Abatement, Minutes of Evidence, TNA, HLG 55/42.

[81] Interim Report of the Committee on Smoke and Noxious Vapours Abatement (London, 1920) [Cmd. 755], 1. APAB Minutes, July 1, 1920, MCL, GB127.M901/12166.

to convince the government to mandate efficiency standards for producing heat and hot water in the home.

Time was of the essence. Britain was in the midst of a state-supported housing boom: the fulfillment of David Lloyd George's pledge to build a half a million "homes fit for heroes" returning from the front in France.[82] The committee members agreed "that the great housing schemes, which are now being undertaken with the aid of the Government subsidy, afford a unique opportunity for securing the adoption of these methods in the new houses."[83] The idea that new houses should have efficient appliances was not new. About a year before, Ernest Simon had made this case in an editorial for the *Manchester Guardian*, noting that his own Air Pollution Advisory Board had "very definite and useful ideas on this matter."[84]

In outlining the scope and severity of smoke pollution, Newton Committee members were especially taken with a particular piece of evidence presented by Marion Fitzgerald. "A valuable investigation was made in 1918 by the Manchester Air Pollution Advisory Board into the comparative cost of household washing in Manchester," the report noted. "The total loss for the whole city, taking the extra cost of fuel and washing materials alone . . . works out at over 290,000*l*. a year." In a footnote, the committee clarified that at the time of the investigation the extra cost was about £242,000, but "since then, owing to the increased cost of washing materials, the figure has increased to £291,246 *l*."[85] It was this line that was the proximate source of Pigou's famous footnote.[86]

State Action

Reformers like those on the Newton Committee wanted the government to legislate standards that would prevent coal burners—factories and individuals

[82] Mark Swenarton, *Homes Fit for Heroes: The Politics and Architecture of Early State Housing in Britain* (London, 2018 [1981]); Peter Scott, *The Making of the Modern British Home: The Suburban Semi and Family Life between the Wars* (Oxford, 2013), chap. 2.

[83] Interim Report of the Committee on Smoke and Noxious Vapours Abatement (London, 1920) [Cmd. 755], 1. The interim report recommended that the "Central Housing Authority . . . decline to sanction any housing scheme submitted by a local authority . . . unless specific provision is made . . . for the adoption of smokeless methods for supplying the required heat as suggested in our interim report." See also Memorandum to Housing Commissioners no. 117, December 4, 1920, TNA, HLG 55/42, drafted by the Newton Committee, which suggested best practices for new buildings.

[84] E. D. Simon, "Manchester's Housing Problem: II—Where to Build," *Manchester Guardian*, March 26, 1919, 12. See also "Smoke and Housing: A Great Opportunity," *Observer*, December 21, 1919, 16. On indoor heating in council houses, see Wetherell, *Foundations*, chap. 3.

[85] Interim Report of the Committee on Smoke and Noxious Vapours Abatement, 3.

[86] Pigou referenced the report explicitly. Pigou, *Economics of Welfare*, 186–87n.

alike—from engaging in inefficient, wasteful, or especially polluting practices. As the Newton Committee's interim report put it, "not only are the valuable by-products of tar oils, ammonia, sulphur and cyanogen compounds lost, but, in addition, a large proportion of unconsumed fuel escapes in the form of soot owing to inefficient appliances." This was a waste and a cost that the government could easily and unobtrusively prevent.

But this did not mean that smoke reformers were advocating for aggressive or direct state action like taxing pollution, as Pigou had already suggested. Lord Newton was a staunch Conservative. He was calling not for taxes on industry, but merely for the state to stipulate standards for new technology, to encourage research on such technology, and to provide incentives for the expansion of "cleaner" energy sources, particularly electricity and gas.[87] Indeed, the Newton Committee's interim report suggested state action on pollution only in the context of much more dramatic state action that was already underway. Anti-smoke regulations were to be little more than riders to the massive state scheme for building new housing after World War I.[88]

That the recommendations were so unobtrusive made Newton all the more upset when they were ignored. In November 1920, five months after the report was published, Newton rose in the House of Lords to question why the government had not acted on the committee's recommendations. "The present," he explained, "is a unique opportunity for dealing with this grievance in view of the enormous number of houses now being constructed throughout the country, largely subsidised by the Government. In these circumstances it seems only natural that the Government should have power to enforce, if they so choose, certain restrictions with the idea of abating the evil."[89] But nothing was being done. "Practically no attention whatever has been paid to the recommendations we made. These new buildings, as any one can see, are all being constructed on the old wasteful extravagant system of heating."[90]

In its final report in late 1921, Newton's Departmental Committee recommended that the state lightly regulate both industrial and residential chimneys.[91] But this report was not even circulated to parliament, despite (or perhaps because of) Lord Newton's assertion that "anyone who has paid any attention to this question, or who has read the Report, will recognise that the time for Government

[87] Interim Report of the Committee on Smoke and Noxious Vapours Abatement, 4–5.

[88] Though the legislation that provided for housing envisioned 500,000 new houses, only around 170,000 houses were built under the 1919 Addison Act by 1921. Scott, *Making of the Modern British Home*, 41.

[89] *Hansard*, HL Debate, November 29, 1920, vol. 42 cc. 697–98.

[90] *Hansard*, HL Debate, November 29, 1920, vol. 42, cc. 697–98.

[91] See Ministry of Health, Report of Committee on Smoke and Noxious Vapours Abatement, January 9, 1922, TNA, HLG 55/17.

action has arrived."[92] In the words of the Ministry of Health's official response, "legislative changes are necessary; but the present time is not opportune for this purpose."[93] It was politically unfeasible for politicians to propose regulating the tens of millions of coal fires used in private homes.[94] As Health Minister Alfred Mond put it to reformers, "I doubt whether the country or Parliament would support me in introducing legislation which would compel people to abolish the open hearth, which is England's favourite and unique distinction; and at the same time inflict on them in these hard days a great expenditure."[95] By 1922, even modest reform had stalled.

It was with this fact bitterly in mind that Newton composed the preface to *The Smokeless City*, a reformist tract published that year. "It is a remarkable and deplorable fact," he wrote, "that the very Ministry [of Health] which was established to protect the health of the people has hitherto completely ignored the damage, waste, and discomfort caused by domestic smoke."[96]

The two authors of *The Smokeless City* were Marion Fitzgerald and Ernest Simon. Like Margaret Fishenden, both Simon and Fitzgerald had moved up in the world since the Manchester Air Pollution Advisory Board had been founded a decade before. Fitzgerald had moved to London where she became associated with the Royal Sanitary Institute (the forebear of today's Royal Society for Public Health). Simon had become Lord Mayor of Manchester. But neither had wavered in their commitment to smoke reform. In *The Smokeless City*, Fitzgerald and Simon rehashed the Manchester board's conclusions, again focusing on domestic sources of air pollution. "The first step on the road to success," they wrote, "is to realise that the house chimney is a much more dangerous enemy than the factory chimney, both because domestic smoke is far greater in quantity and far more harmful in quality than factory smoke, and because factory smoke is already rapidly decreasing." Quoting figures from scientists in London and Leeds, Fitzgerald and Simon estimated that "very nearly four-fifths of the total pollution of the air is due to domestic smoke."[97]

[92] That is, the final report was not printed as a Parliamentary Command Paper, as the interim report had been. *Hansard*, May 10, 1922, vol. 50, c. 374.

[93] The minister would not even "ask Local Authorities . . . to appoint the additional officers . . . which would be required" to carry out the Newton Committee recommendations. Indeed, the minister noted that "the present provisions, though not of the best, are [not] an insurmountable hindrance to action." Smoke Abatement Statement, February 1, 1922, TNA, HLG 55/17.

[94] See Ministry of Fuel and Power and Ministry of Works, Memorandum on District Heating as Applied to Small Housing Estates," August 1946, TNA, HLG 55/42.

[95] Minutes of Meeting with Sir Alfred Mond, n.d. [February 1922], TNA, HLG 55/17.

[96] Newton, "Preface," in Simon and Fitzgerald, *Smokeless City*, vi–vii.

[97] Simon and Fitzgerald, *Smokeless City*, 3–4, 18.

Recapitulating the conclusions of experiments done in Manchester and the arguments of the Newton Committee, Fitzgerald and Simon concluded the book with suggestions for "what can be done." First and foremost, the two authors pointed to research—particularly on "smokeless solid domestic fuel" as recommended by Margaret Fishenden—to be undertaken at government expense. They noted that the "Government has shown wisdom and foresight in investigating this matter through the Fuel Research Board."[98] Fitzgerald and Simon also called for educating the public, similarly at state initiative, and mandating that new houses built by municipalities employ efficient heating methods. None of these suggestions were new, and though they required state action, none of them necessitated significant new investment or active intervention.

Newton and his allies kept enough pressure on the government through the early 1920s to keep the possibility of anti-smoke legislation alive. Though regulation of domestic pollution was off the table, some limited action against highly visible industrial chimneys was politically plausible. And so, the Ministry of Health—in collaboration with the Smoke Abatement Society—drafted a bill that would, at least, enable some future action against industrial polluters.[99] It was not radical; the ministry stressed that it "wish[ed] to be as helpful to manufacturers and others as is consistent with public welfare."[100] After several years and several compromises with an industry lobbying group, the National Union of Manufacturers, the government finally introduced a smoke abatement bill loosely inspired by the Newton Committee in 1926.[101]

In presenting the bill to the House of Commons, then Minister of Health Neville Chamberlain invoked the same research from the Manchester Air Pollution Advisory Board that Newton's Committee and Pigou quoted, though Chamberlain took some liberties with the report, mistaking Harrogate for Halifax and slightly inflating the estimated cost to Mancunian residents. "There was an interesting inquiry in 1918 in Manchester," Chamberlain asserted, "comparing the cost of washing per household in that somewhat dirty town . . . with the cost of washing in Halifax . . . [and] the inhabitants of Manchester, in order to keep themselves as clean as those of Halifax, had to spend every week 7½ d. more in the cost of washing. . . . Manchester was spending something like £300,000 a year more than it ought to have done if it had been as clean as Halifax."[102] Chamberlain concluded that "pollution of the atmosphere in our larger

[98] Simon and Fitzgerald, *Smokeless City*, 72–73.

[99] An Act to provide for the Abatement of Smoke, May 18, 1922, TNA, HLG 55/17; I. G. Gibbon to Aubrey Symonds, March 24, 1922.

[100] Smoke Abatement Statement, February 1, 1922, TNA, HLG 55/17.

[101] Flick, "Movement for Smoke Abatement," 38–39. On the Air Pollution Advisory Board's comments on the draft bill, see Air Pollution Advisory Board Meeting, Minutes, October 12, 1922, Manchester Central Library, GB127.M901/12166.

[102] *Hansard*, HC Debate, June 22, 1926, vol. 197, cc. 266–67.

towns is at once costly, wasteful, and highly injurious." No one could disagree with that.

Still, the act that ultimately passed—the Public Health (Smoke Abatement) Act of 1926—was feeble. Just before the bill was introduced in Parliament, Chamberlain circulated a memorandum to the Cabinet in which he admitted that "the principal criticism of the Bill is likely to be that it is not sufficiently drastic; but in the present state of industry a more severe measure does not seem expedient."[103] Economic conditions were grim. In May 1926, 1.7 million British workers walked out of work in a General Strike. With unemployment up and wide swaths of British industry in crisis, the Cabinet agreed that the time was still not right for strict environmental regulation.[104] As a result, though the act classified smoke of any sort to be an offense if it was a "nuisance," it left both the particular definition of nuisance and the enforcement of any measure up to local authorities. Moreover, the act did not apply at all to private residences.[105] Real progress in air pollution reform would have to wait until the 1950s, in the aftermath of the devastating London fog of 1952.[106]

Environmental Economics and Taxes

In Pigou's rendering, smoke pollution was an external diseconomy to society; it had a cost that was outside the reach of the price system. Pigou's proposal—a typically liberal one—was simply to bring this cost into the reach of the price system. Once polluters were responsible for paying pollution's economic costs, they would have incentives to reduce or prevent pollution. This is the idea behind carbon taxes today. Vitally, in Pigou's presentation, smoke came "from factory chimneys."[107] That is, the polluters were factory owners—a small part of the population. The only way to get factory owners to pay the economic costs of pollution was for the state to intervene: to calculate those costs and then to levy them on the factory owners in the form of taxes.

The situation described by smoke reformers like Margaret Fishenden, Marion Fitzgerald, and Ernest Simon was very different. "Polluter" was not synonymous with "industrialist"; rather, everyone was a polluter. Although it was true that the poor bore a cost disproportionate to their means and their consumption of coal, the poor were, at the very least, complicit in pollution. This fact did not make coal smoke any less of an external diseconomy; the retail price of coal still

[103] Neville Chamberlain, Public Health (Smoke Abatement) Bill, Memorandum by the Minister of Health C.P. 87 (26), March 1926, TNA, CAB 24/178/88.
[104] Minutes of the Cabinet, March 10, 1926, TNA, CAB 23/52/10, p. 9
[105] Public Health (Smoke Abatement) Act, 1926, 16 & 17 Geo. V. c. 43.
[106] Thorsheim, *Inventing Pollution*, chap, 11.
[107] Pigou, *Economics of Welfare*, 184.

did not account for the massive costs that its consumption entailed. But if the poor themselves were the polluters, a tax on pollution would have very different distributional effects than the tax envisioned by Pigou. Instead of redistributing resources from the rich to the poor, as Pigou would have it, such a consumption tax would only further disadvantage the poor.

Although reformers like Fishenden, Fitzgerald, and Simon did not have the language of formal economics that Pigou was developing, they certainly understood this dynamic. As Lord Newton put it in the preface to *The Smokeless City*, "no one in his senses would propose that the household should be forthwith compelled by law to substitute some other form of heating for his existing open coal fire," even if "from the view of cleanliness, cheap coal has been little short of a curse."[108] Although a few radical Liberal observers called for a direct tax on coal to reduce its use, most reformers refrained from such suggestions.[109] As it was put by two such reformers in 1925, "the project of taxing the whole country of the sake of the atmosphere of the towns is sure to be regarded as inequitable."[110] Fitzgerald and Simon were even more vociferous: "everybody agrees that . . . a tax [on fuel] falls unduly on the poor, and is in every way a bad tax."[111]

But as smoke abatement reformers understood, British municipalities were already taxing energy consumption, albeit in a way that actually encouraged smoke pollution. In many cities, including Manchester, the municipality was responsible for providing clean-burning gas (itself made from coal).[112] And many of those municipalities did not provide gas at cost, but instead used the gas utility to turn a small profit, which they used to lower council taxes. This policy amounted to "deliberately putting a tax on the use of gas."[113] Although such "taxes" had positive redistributional effects of the sort championed by progressives, they were antithetical to the cause of smoke reduction, and, as such, widely condemned by reformers. In 1915, after hearing from members of the Manchester Air Pollution Advisory Board, the British Association (the precursor to today's British Science Association) denounced Manchester for "heavily taxing the gas consumers for the relief of the rates." "It was undoubtedly bad policy

[108] Newton, "Preface," in Simon and Fitzgerald, *Smokeless City*, vii–viii.

[109] See Percy Alden, "Coal Smoke Abatement," *Contemporary Review* (December 1922): 725–33. Alden described a tax on coal on Pigovian lines. So did an observer in *The Spectator* in a review of *Smokeless City*. "The Smokeless City," *Spectator*, 129, issue 4920 (October 14, 1922): 492–93. See also Thorsheim, *Inventing Pollution*, 130.

[110] Sir William Napier Shaw and John Switzer Owens, *The Smoke Problem of Great Cities* (London, 1925), 284.

[111] Simon and Fitzgerald, *Smokeless City*, 77.

[112] For Manchester Gas records, see North West Gas Board, Manchester Group, MCL, GB 127.M27.

[113] Simon and Fitzgerald, *Smokeless City*, 76; Thorsheim, *Inventing Pollution*, 152–53.

from every point of view."[114] Ernest Simon was particularly vocal in his resistance to the city's effort to use gas revenues to reduce taxes. So too was his wife, Shena Dorothy Simon, who submitted a petition to the City Council signed by 534 members of the Manchester and Salford Women Citizens Association.[115]

The use of coal gas or coke was not the panacea that reformers envisioned. Though these "smokeless" fuels might have reduced domestic pollution, their manufacture was a tremendously dirty and polluting process, one that, as Peter Thorsheim put it, largely "displaced [pollution] from one environment and group of people to another."[116] This was an inconvenient truth, largely overlooked by reformers.

Still, Fitzgerald, Simon, and their colleagues were exorcised by the purported tax on gas users. They asserted that it was "high time that a general act was passed rendering it once and for all illegal."[117] "Taxes" of the sort excoriated by Fitzgerald and Simon were not designed to affect consumer behavior; they were primarily intended by local authorities to be sources of revenue, the conventionally accepted purpose of any tax.[118] But they nevertheless disincentivized the collective uptake of a "cleaner" energy source. Instead of taxing polluters, the municipalities were—perhaps inadvertently—taxing everyone who was *not* polluting. When it came to taxes, Fitzgerald and Simon argued that the state should do less rather than more, the opposite of Pigou's remedy for smoke pollution.

This is not to say that the reformers were opposed to state action. Fitzgerald, Fishenden, and Simon were all officials of the Manchester Corporation. The Air Pollution Advisory Board was an official body of the municipal government. Smoke reformers understood that it fell to governments—both municipal and national—to conduct scientific and industrial research, whether through bodies like the Advisory Board or the DSIR. They also saw the state as a regulator in the service of protecting public health. Prohibiting certain practices and fining or otherwise punishing certain offenders was fully consistent with the state's well-established role as the guarantor of public health. The Alkali Inspectorate, Britain's only nationwide environmental regulator, had been formed in 1864 to

[114] "The British Association on Some Aspects of the War," *Manchester Courier and Lancashire General Advertiser*, September 10, 1915, 4. "The Smoke Nuisance: £1,000,000 a Year Wasted in Manchester," *Manchester Guardian*, September 10, 1915, 4; "The Smoke Evil: An Endless Daily Fight with Dirt," *Manchester Guardian*, January 15, 1914, 11. See also "Manchester Council," *Manchester Guardian*, May 6, 1915, 3.

[115] "Municipal Trading: The Relief of Rates in Manchester," *Manchester Guardian*, March 28, 1918, 8. See also APAB Minutes, February 28, 1918, MCL, GB127.M901/12166.

[116] Thorsheim, *Inventing Pollution*, 136–47.

[117] Simon and Fitzgerald, *Smokeless City*, 77.

[118] This is the prime way that Pigou himself understood most taxes. A. C. Pigou, *A Study in Public Finance* (London, 1928).

limit factories from discharging hydrogen chloride on the grounds that the acid rains and mists that it caused were devastating for nearby vegetation and human health.[119] The Air Pollution Advisory Board itself reported to the Sanitary Committee of the Manchester Corporation; the legislation that was ultimately passed in 1926 was called the Public Health (Smoke Abatement) Act.[120]

Moreover, like Pigou, reformers had long understood that air pollution had costs. Robert Angus Smith, the first Chief Inspector of the Alkali Inspectorate, was acutely aware that the damage caused by pollution had a cost; throughout the 1850s and 1860s, the harm done to local property was the subject of frequent civil lawsuits that he closely followed. Rollo Russell, working in the 1880s, similarly understood that pollution caused damage and that such damage had monetary costs. In 1880, he guessed that the cost of "extra washing" in London, for example, was £1,100,000, though there was little work to support this figure—certainly none like the work done in Manchester.[121] Reformers affiliated with the Manchester Air Pollution Advisory Board were particularly attuned to the economic costs of pollution. After all, it was Fitzgerald's research on comparative laundry costs that Pigou quoted in his own work.

In this way, they were unambiguously economic thinkers, though not economists. Fitzgerald wrote of the importance of "counting the cost" of smoke pollution. Laundry costs were higher, but so too were the costs of painting, building repair, and lighting because of darker days.[122] Pollution was also a physical embodiment of waste. As Fitzgerald and Simon put it in *The Smokeless City*: "Manchester might be a much healthier and infinitely pleasanter place than it is, if the public would realise that smoke abatement is not a fad, but a *business proposition*, closely linked with, and no less important to the nation than, the great question of fuel economy."[123] And fuel economy was an argument for which every British citizen who had lived through the wartime years would have been primed. The reformers, in short, very much understood smoke pollution not only as a problem that the state should take a hand in solving but also as an economic problem, a problem with economic costs.

[119] The inspectorate lacked authority to regulate coal smoke. See Peter Reed, "The Alkali Inspectorate 1874–1906: Pressure for Wider and Tighter Pollution Regulation," *Ambix* 59, no. 2 (July 2012): 131–51; Roy M. McLeod, "The Alkali Acts Administration, 1863–84: The Emergence of the Civil Scientist," *Victorian Studies* 9, no. 2 (December 1965): 85–112. On Smith and acid rain, see Smith, "On the Air of Towns," *Quarterly Journal of the Chemical Society* 11 (1859): 232.

[120] See, e.g., Tom Crook, *Governing Systems: Modernity and the Making of Public Health in England, 1830–1910* (Berkeley, CA, 2016).

[121] Russell, *London Fogs*, 37.

[122] Marion Fitzgerald, "Cleansing the Sky Part I," *Garden Cities and Town Planning* 14, no. 1 (January 1924): 62.

[123] Simon and Fitzgerald, *Smokeless City*, 78.

And so, Mancunians and their allies across the country justified state action to remedy smoke in two ways. First, insofar as smoke was a menace to public health, the state had the ability to regulate pollution and discipline offenders, a task conventionally left to municipal authorities. Second, insofar as the "smoke nuisance" imposed economic costs, the state could encourage polluters to see how their own actions were not always serving their own interests. The state might do this through propaganda, publicity, and research, all of which were employed by the Manchester Air Pollution Advisory Board.[124]

Pigou's conceptualized pollution differently. By reframing pollution as an external diseconomy, Pigou figured it as both a social and an economic cost. In essence, he combined the two rationales for state action that smoke reformers applied to pollution: the social aspect of public health and the economic understanding of it as a cost. But what really separated Pigou from the reformers was, perhaps, the understanding of what a tax could be and what a tax could do. For Pigou, the correct state response to a social cost was to tax it—not because a tax would raise revenue for the state, but instead because a tax would change behavior. This suggested an economic role for the state that was far deeper than the one suggested by reformers. In Pigou's rendering, the state had a fundamental role in guaranteeing the entire working order of the price system. Smoke abatement reformers implicitly thought that educating polluters as to the true costs of coal consumption would be enough to shift in behavior, Pigou understood that the state would ultimately have to take action to change prices. The simplest way to achieve that goal was by "'extraordinary encouragements' or 'extraordinary restraints' upon investments. . . . The most obvious forms which these encouragements and restraints may assume are, of course, bounties and taxes."[125]

Conclusion

A. C. Pigou was neither a politician nor an activist. His brief brushes with policymaking in London in the 1920s ended in frustration.[126] Writing later, he would lament "how very unlike philosopher kings actual politicians are! To how small an extent the conduct of affairs is the result of thought!"[127] Pigou was an economist. Comfortably ensconced in green and bucolic Cambridge, unburdened by the pressures of mass politics or bureaucratic policymaking, for

[124] "Black Smoke Scandal: Work of the Abatement League," *Manchester Guardian*, October 16, 1913; Sanitary Committee Minutes, December 18, 1912, MCL, GB127.Council Minutes/Sanitary and Public Health Committee/11, f. 176.

[125] Pigou, *Economics of Welfare*, 192.

[126] Kumekawa, *First Serious Optimist*, chap. 4.

[127] A. C. Pigou, "Presidential Address," *Economic Journal* 49, no. 194 (June 1939): 221.

Pigou the problem of pollution was academic. It fit neatly into an analytical framework that he had been developing for some time. Pollution was a straightforward social cost; in Pigou's rendering, it literally became the textbook example of a negative externality.[128] As such, pollution had a straightforward solution: taxes. If the state taxed the people whose economic activity rendered an unaccounted cost on everyone else, the externality would no longer be external to the market. In Pigou's simplified rendering, the owners of "factory chimneys" would pay into a common pot as a condition for continuing to belch smoke into the sky.[129]

This was all well and good on paper, but as reformers in Manchester and London understood, the situation was significantly more complicated in the real world. There were social and historical values of smoke with which to contend, not to mention gendered assumptions about responsibility, entrenched economic interests, and deeply held ideologies about the proper role of the state. All of these factors made reducing pollution more difficult than Pigou's theory suggested. The single most important factor, however, concerned the question of *who* was a polluter. Pigou, the professor living far from industrial cities, equated smoke with factories. It was the masculine factory owner who was responsible for the "smoke evil" that cost Mancunians so much on their laundry and house painting bills. For reformers living in Manchester itself, it was obvious that everyone who burned coal—which included everyone in the city—was a polluter. Taxing pollution meant taxing coal itself; it meant taxing the feminine-coded hearth and stove. And whereas Pigou's tax was intended to benefit the poor, a simple tax on coal pollution might have the opposite effect. It was, in any case, a political dead end. The only way forward was to wage a battle for hearts and minds: an education and propaganda campaign that shifted attitudes about traditional energy sources and encouraged the adoption of newer, cleaner ones, whether coke cakes, gas, or electricity.

Though they were not economists—perhaps precisely because they were not economists—the Manchester reformers grasped the political economy of pollution far better than Pigou did. Pigou distilled data into a theory that studiously ignored political and social contexts. Arguably, this is what made his theory so important to subsequent generations of economists. But insofar as Pigou's goal was to bear fruit rather than just shed light, it is clear that the fruits of Pigou's theories would not be harvested until after his death in 1959. His theorizing did little to change policy or behavior in the short run, as taxing polluters was a political nonstarter. As historians of economics have recently contended, even

[128] Pollution has been estimated to account for 70 percent of all social costs in Britain in the 1880s and about 50 percent in the 1920s. Roger Fouquet, "Long Run Trends in Energy-Related External Costs," *Ecological Economics* 70 (2011): 2380–89.

[129] Pigou, *Economics of Welfare*, 185.

within academic economics, Pigou's ideas on pollution did not become widely cited until the 1960s.[130]

What, then, can be said of the role of the Manchester reformers—and non-economist economic thinkers more generally—in the history of environmental economics? The borders of an academic discipline are typically determined by its practitioners; the community polices its own boundaries. But there was no such thing as "environmental economics" in the 1920s; the field only emerged as an actor's category in the mid-century. The decision to valorize Pigou as an intellectual forerunner, a precursor to the subfield of environmental economics, occurred only in the 1960s and 1970s, once the subfield was established. Pigou's status as an important antecedent was crafted by posterity, and by economists in particular. Drawing lines around a discipline is very different matter than drawing lines around the history of a discipline or around the ideas that have motivated, animated, or guided it. This article suggests that if Pigou should be studied with regard to the history of environmental economics, so too should the Manchester smoke reformers, if only by connection.

Historians should do what Pigou did not: to conceptualize the Manchester reformers not just as sources of data, but also as sources of ideas and thoughts. Doing so not only provides new context for Pigou's own influence within the subsequent history of environmental economics; it also demonstrates how Pigou himself belonged to a larger ecology of people thinking about the intersection of the environmental and the economic. By contextualizing Pigou's ideas and the ways in which they related to other ideas of his time, it is possible to better understand how theories that later took root in the economics profession developed and changed in significance. In any event, the story of Pigou's engagement with the Manchester reformers is an object lesson in the slippage between theory and practice. Understanding that slippage is a vital role of the history of economics, and of intellectual history more generally.

The foregoing pertains to history: to the narration of the past. But much in the story of smoke pollution in the early twentieth century rhymes with that of climate change in the early twenty-first. Reformers now push "clean" energy and urge the usage of efficient appliances in much the same way that reformers a hundred years ago did. Now as then, there is an ongoing debate as to the relative importance of personal consumption decisions, as opposed to large corporate actions, in slowing the degradation of the environment. Many progressive politicians in wealthy countries have sought to focus attention not on individuals but on corporations as the loci of political action.[131] Big businesses have done

[130] Banzhaf, "History of Pollution"; Medema, "Exceptional and Unimportant?"

[131] See, for instance, Elizabeth Warren, "My Green Manufacturing Plan for America," Medium.com, June 4, 2019, https://medium.com/@teamwarren/my-green-manufacturing-plan-for-america-fc0ad53ab614.

the opposite; the term "carbon footprint" was advanced by a British Petroleum advertising campaign in the 2000s as a way of shifting responsibility onto individuals.[132] At the same time, many activists and reformers focus on individual consumption decisions—whether the choice concerns food, transportation, or fuel. In India, domestic stoves are a key object of concern, in ways that recall the concerns treated in this article.[133] The prognosis for climate change remains incredibly grim.[134] Today, as it was a hundred years ago, it is difficult for many to imagine the transition from traditional energy sources (coal then, hydrocarbons now) to newer, "cleaner" ones. But today, a new, very different energy landscape in the future is at least imaginable: electric cars are status symbols and ever-larger windmills are rising around the world.

Successfully confronting climate change will require thinking inspired by and descended from both Pigou and the smoke abatement reformers. Like Pigou, we must recognize the social costs of greenhouse gas emissions and empower the state to tax and regulate the largest emitters. Like Fishenden, Fitzgerald, and Simon, we must root solutions in practical, local knowledge; there is good reason to be "pragmatic."[135] More specifically, we must recognize that a wide swath of the population participates in or is complicit in creating harmful emissions, and that though efficiency matters, a truly durable solution will necessarily involve winning hearts and minds in preparation for a very difficult political fight. Doing so will require not just sweeping state action of the sort that Pigou envisioned but also research and public relations campaigns to shape citizen knowledge reminiscent of the efforts of smoke abatement reformers; after all, state action, research, and public opinion are closely related. Doing so will, above all, require taking seriously a variety of forms of economic thinking, not just the thinking done by people employed as economists.

[132] William Safire, "Footprint," *New York Times Magazine*, February 17, 2008, https://www.nytimes.com/2008/02/17/magazine/17wwln-safire-t.html.

[133] See, for instance, Hanna Rema, Esther Duflo, and Michael Greenstone, "Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves," *American Economic Journal: Economic Policy* 8, no. 1 (2016): 80–114.

[134] World Meteorological Organization, State of Global Climate 2020, 2020, https://public.wmo.int/en/media/press-release/2020-track-be-one-of-three-warmest-years-record; NOAA, Global Climate Report, 2020, https://www.ncdc.noaa.gov/sotc/global/202013.

[135] For a survey on such approaches, see Jo Guldi, "The Climate Emergency Demands a New Kind of History: Pragmatic Approaches from Science and Technology Studies, Text Mining, and Affiliated Disciplines," *Isis* 113, no. 2 (June 2022): 352–65.